Citation:

Phillips SM, Bandini LG, Naumova EN, Cyr H, Colclough S, Dietz WH, Must A. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res.* 2004;12:461-472.
PubMed ID: 15044663

Study Design:

Cohort study (longitudinal, prospective)

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the longitudinal relationship of energy-dense snack (EDS) food intake with relative weight status and body fat percentage and to examine how EDS food consumption is related to television viewing.

Inclusion Criteria:

1. Non-obese (TSF ≤85th percentiles for age and sex according to NHANES I)
2. Premenarcheal
3. Female
4. In good health as assessed by physical exam and medical histories.

Exclusion Criteria:

1. Less than 12 items blank on FFQ
2. Daily energy intake below 500 or over 5,000 kcals
3. Less than three annual visits.

Description of Study Protocol:

Recruitment and Design

- Massachusetts Institute of Technology Growth and Development Study: All fourth and fifth grade girls in Cambridge, Massachusetts, public schools were invited to participate with additional subjects recruited from the MIT summer day camp and through contact with friends and siblings of subjects between 1990 and 1993.

Statistical Analysis

- Independent variables log transformed when necessary
- Percentage of kcals from five groups expressed in quartiles because data not normally

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distributed
- Linear mixed effect modeling.

Data Collection Summary:

Timing of Measurements

- Subjects followed annually until four years after menarche.

Dependent Variables

- BMI Z-score (measured height and weight, using CDC charts)
- Body fat percentage (BIA and equations developed in study using $H_2{}^{18}O$ dilution to validate).

Independent Variables

Diet: Willet 116-item semiquantitative FFQ about diet in past year

- Version from early 1990s
- Designed for children
- Based on validated semiquantitative FFQ for adults
- Annually self-administered
- Nine response categories ranging from "never or <1 per month" to "6 or more per day."

Energy-dense snack food intake (total servings per day, total percentage kcals and percentage kcals from each of five categories):

- Baked goods: Cookies, pies, cakes and brownies
- Ice cream: Ice cream, ice cream sundaes, sherbet and milkshakes
- Chips: Potato chips and corn chips
- Candy: Chocolate and non-chocolate
- Soda: Only sugar-sweetened.

Control Variables

Besides age and parental overweight, only those variables were selected that were significant predictors of both independent and dependent variables.

- Fruit and vegetable servings (FFQ)
- Percentage of kcals from protein, fat and CHO (FFQ)
- Physical activity: Two 24-hour recalls of hourly participation in five types of activities:
    - Sleeping or lying down
    - Sitting or standing
    - Walking
    - Vigorous activity.
- Separate physical activity time blocks completed for school and weekend days; two variables derived:
    - Physical activity index (hours per day) for walking and vigorous activity time
    - Inactivity time (hours per day) for sleeping, lying, sitting and standing; validated elsewhere.
- Age

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- Age at menarche (self-reported)
- Parental overweight (at least one parent with BMI>25 kg/m^2; not stated if measured or self-report).

Description of Actual Data Sample:

- *Initial N:* 196 girls
- *Attrition (final N):* 178 girls (91% of original), representing 1,198 data points with an average of 7.7 annual measurements per subject
- *Age:* Eight to 12 years at baseline (mean 10 years), mean of 17 years at follow-up
- *Ethnicity:* 75% white, 14% black, 11% other
- *Location:* Cambridge, Massachusetts.

Summary of Results:

Energy-Dense Snack (total)

- No relation with BMI Z-score
- No relation with body fat percentage.

Soda

- Only EDS food found to be positively related to BMI Z-score (P<0.001)
- Subjects in third and fourth quartiles of percentage of kcals from soda had BMI Z-scores that were 0.17 unties higher on average than subjects in the first quartiles
- When data were stratified by menarcheal status (pre- vs. postmenarche), the relationship between BMI Z-score and soda intake was significant only during the postmenarcheal period
- Table adjusted for age, age at menarche, parental overweight, and servings of fruits and vegetables (does not mention other control variables)
- No relationship with body fat percentage.

TV

- A similar grid was completed for TV viewing as for physical activity, included watching videos and playing video games.
- Positively related to EDS foods (whether expressed as svgs or kcals) (P<0.001).

Physical Activity

- No relationship with ESD foods.

Author Conclusion:

In this cohort of initially nonobese girls, overall EDS food consumption does not seem to influence weight status or fatness change over the adolescent period. A possible exception to this overall finding is soda consumption, where we saw a significant positive longitudinal relationship with BMI Z-score. We did not see a similar effect of soda consumption on body fatness changes over adolescence. Although the effect size for the estimated impact of soda consumption on BMI Z-score is not large, it could be important on a population basis, given the rising trend in soda consumption. Furthermore, aside from any potential impact on weight status, high consumption of

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EDS foods may be of concern because of their low nutrient density. These data also reinforce the notion that limiting TV time may modify EDS food consumption.

Reviewer Comments:

Strengths

- *Longitudinal analysis*
- *Long study duration*
- *Annual measurements*
- *Body fat measured, not only BMI*
- *Validated instruments.*

Limitations

- *Not all subjects had data at baseline or at end of study*
- *FFQ is semiquantitative (R=0.33 between FFQ and seven-day diet record on EDS foods)*
- *Only girls were included*
- *No assessment of timing of eating (not clear if EDS eaten as snacks)*
- *It does not seem, from the description, if the analyzed change in intake is an independent variable and the change in BMI Z-score and the change in body fat percentage are outcome variables.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes

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1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A

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5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	No
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes

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	7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	???
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	No

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